D14-6

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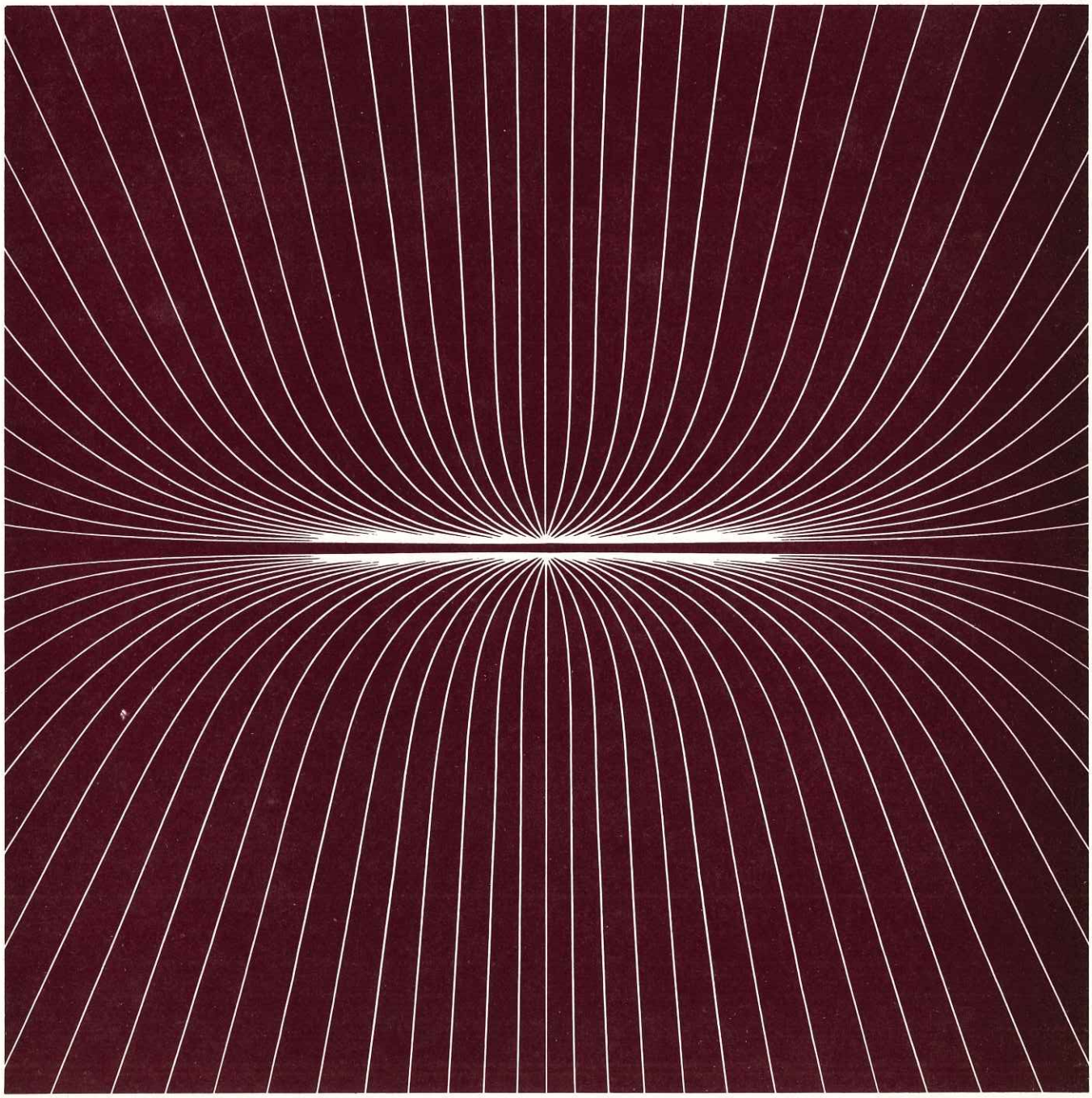
harman/kardon

HK2000

stereo cassette deck



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reset
record
Dolby nr
peak
harman kardon
harman kardon
record calibrate
playback calibrate
test
DOLBY SYSTEM
l
r
record level
playback level
eject
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stop
pause
mic levels
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mpx filter
low noise tape
memory
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out
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headphones

At Harman Kardon, we have an attitude about high fidelity instruments: to give the finest expression to every function of music reproduction.

We consider that the cassette deck has a definite and honorable utility as a means of conveniently capturing, retaining and reproducing material from records, tapes or radio broadcasts.

With one major caveat. It must perform on a level equivalent to the source.

The specifications of the HK2000 offer measurable evidence of its quality. But performance specifications are only one influence on sound quality. Just as in all Harman Kardon amplifiers and receivers, the wide-band design characteristic of the HK2000 produces sound quality that transcends its impressive specifications.

It utilizes narrow-gap, hard-faced, permalloy metal heads (the only heads used in professional studio tape machines) for extended frequency response and low distortion. Low frequency response is so linear that the HK2000 required the incorporation of a subsonic filter control that can be used to remove signals issued by warped discs.

These few factors, while not decisive in themselves, indicate the *attitude* with which the HK2000 was conceived and built.

A Short History

We were among the first to recognize the potential of the cassette deck. Up to that time it had been an interesting toy, more suited for portable use than for high fidelity application. Harman Kardon engineers began to improve both mechanics and electronics resulting in the CAD 4, a deck that deserved the term "high fidelity."

But some problems remained. A cassette tape, moving at 1⅞ inches per second speed tended to have only "acceptable" levels of wow and flutter. Equally important, at that speed, tape hiss was still at a disturbing level.

When Ray Dolby first demonstrated his then new Dolby B noise reduction system it was logical for him to use our CAD 4.

We immediately set about incorporating Dolby into the cassette deck then on our drawing boards.

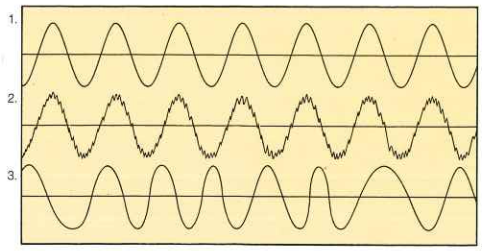
The result was the CAD 5 with an improved drive system and Dolby.

The Harman Kardon HK1000 was a giant step forward. Improvements in both frequency response and phase linearity, the incorporation of super-sensitive meters and DC servo motor drive, and an excellent signal-to-noise ratio resulted in reviews that sounded like ads. High Fidelity Magazine said, "After struggling to detect even small differences in sound between the best commercial materials available . . . and copies made on the HK1000, we feel confident in saying that it will reproduce anything you're likely to feed into it. A superb achievement."

"The HK1000," said High Fidelity, was "the best so far."

When our engineering explorations suggested improvements were feasible, we replaced it.

With the HK2000.



Wow and flutter are two closely related speed aberrations differing only in the subjective effect of the frequency modulations they produce. In contrast to the undistorted waveform (figure 1), the high frequency modulation caused by *flutter* is shown in figure 2. Wow, a low frequency modulation effect, is illustrated in figure 3.

Problems of mechanical performance of a cassette deck.

There are three areas of cassette deck specifications with which audiophiles are appropriately deeply concerned: wow and flutter, signal-to-noise ratio and frequency response.

Wow and flutter are directly related to mechanical function—the rotating components— of the drive system. Flutter is caused by rapid variations of speed as the tape moves through its assigned path. It is recognizable even to untrained ears.

Flutter occurring at a slower rate is called "wow." And wow is also due to rotational irregularities of either the motor or any of the rotating parts of the drive system. Wow can actually change the pitch of frequencies—frequencies that are particularly audible.

Mechanics

The HK2000 incorporates a specially designed DC Servo motor that not only drives the entire system, but assures smoothness and consistency of operation. It easily handles the two essential burdens placed upon a cassette motor. Its regulated DC operation makes it totally insensitive to changes in line voltage and line frequency.

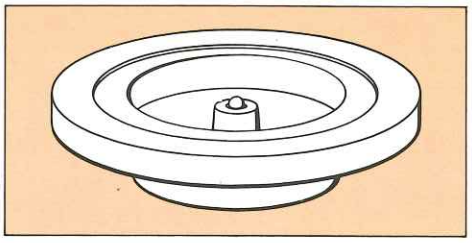
But the physical load on a motor is constantly changing (as the cassette *reel* changes in mass during play). The Servo device functions to further maintain constant speed. The result is consistency of speed (and performance) despite large changes in electrical or mechanical forces.

The flywheel of a cassette deck must have high mass. The HK2000 incorporates a massive flywheel located beneath the capstan which dampens rotational aberrations due to the high inertia of its rotation. Heavy bearings of special formulation bear this added weight. They serve to keep friction low as well.

The drive belt plays as important a role as any other part of the chain of the drive system. Thus, Harman Kardon engineers have given as much attention to this component as to any other. The HK2000 utilizes a belt that is precision ground to ensure smooth, constant coupling from the motor pulley to the flywheel/capstan. The belt will simply not slip or bounce.

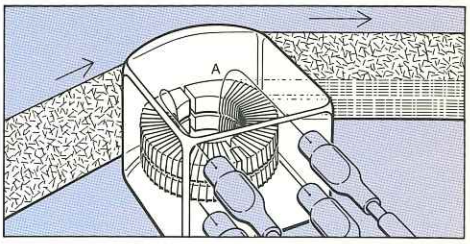
All other key elements, such as the hold-down clips, pinch roller, capstan and eject mechanism are not only perfectly accurate in size and conformation, but are put into place properly aligned and absolutely true.

All electric motors, despite their type, achieve rotational motion through electromagnetic pulsing that contributes to undesirable speed variations. A fly-wheel helps smooth these variations through inertial action. The size and weight of the flywheel used in the HK2000 contributes significantly to its low wow and flutter.



Tape Heads

Audio frequencies applied to the head coil ("figure A") set the polarity of the magnetic particles on the recording tape by electromagnetic induction. During playback these magnetized particles induce audio signals in the playback head coil.



It is obvious that the heads (erase and record/playback) in a recording system are of critical importance to its performance.

In the erase mode, the tape is subjected to an AC field which gradually increases in magnitude, then gradually diminishes to zero. A relatively large gap permits the AC field to spray a large longitudinal area in the tape path magnetic flux. This strong magnetic field rearranges the tape's molecular characteristics and wipes it clean.

In the record/playback mode it is the function of the head to convert electric current to a magnetizing force during recording and reconvert that magnetic pattern to an electronic current during reproduction.

Size, shape, precision in manufacture and installation are all essential to the appropriate functioning of record/playback heads. But even assuming total perfection of these factors (and we are not saying that such an assumption should be automatically made), there remains the question of the basic material of the head itself.

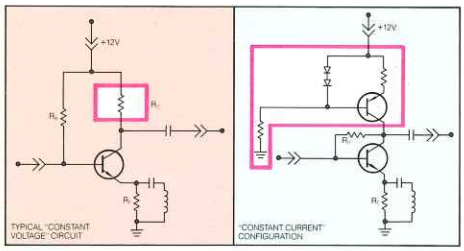
In this respect, the audiophile is presented with essentially two possibilities: metal or ferrite.

Because performance was the determining factor, the choice was an easy one for Harman Kardon engineers. The heads in the HK2000 are composed of a hard-faced permalloy specially suited to magnetic flux. Whereas ferrite heads have a tendency to flake (we are speaking of microscopic, but performance-diminishing particles), no such deficiency is present with the permalloy metal head. Equally important, ferrite heads tend to saturate at lower frequencies, robbing the listener of full enjoyment of the music. The permalloy heads in the HK2000 are heat-treated and super-hard making it capable of extended high frequency response.

A word about contour effect. This is a low frequency aberration (resulting in boomy bass responses) caused by variations of the magnetic flux in the head gap when the tape moves past the head. In the HK2000, the contact surface between the heads and tape is minimized, and careful shielding significantly diminishes amplitude variations caused by the contour effect.

Constant Current Drive

Used widely in professional studio recorders, constant current record drive reduces the electrical influence of the recording head on the record amplifier circuit, improving frequency response uniformity. The additional design time and parts cost is rewarded by better frequency linearity in each machine, and from machine to machine.



A recording head is, in effect, a current-to-flux transducer. That is, its output flux is in proportion to the amount of current entering. Tape machine engineers can drive a recording head circuit by utilizing either constant voltage or constant current.

Constant voltage represents some major drawbacks. Constant voltage means that as frequency varies, the flux will vary because the head impedance is also changing. Such a system (still in astonishingly widespread use) makes it extremely difficult to maintain and control frequency response.

The HK2000 is driven by constant current. Thus the audio voltage of the source material is converted into a proportional current. In this way, although the frequency may (and will) vary, the output remains constant. The result is simplicity of design, a repeatable phenomenon from head to head and unit to unit, and, most important, consistency and control of frequency response across the entire bandwidth.

Features

The **frequency response** of the HK2000 is exceptionally wideband. A subsonic filter has been incorporated to eliminate unwanted signals below 20Hz (such as those issued by warped discs).

FM broadcasts include pilot signals which are inaudible when broadcast, but audible on tape. The **MPX filter control** of the HK2000 can be used to eliminate these unwanted signals when recording from FM.

Mic/line mixing on the HK2000 is isolated. The volume control for the microphone can be operated separately from other input sources.

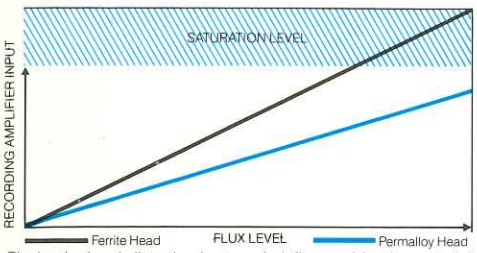
Two illuminated VU meters with specially designed circuitry permit the user to read peaks. This method is more exacting than standard VU meter action which simply rides average levels. The HK2000 eliminates choking of transient peaks. In addition, an **LED** located between the two meters provides instantaneous warning of overload. Aside from being easily read, the LED functions without the problems of inertia presented by the needle indicators of meters.

The **Dolby B noise reduction system** eliminates tape hiss without affecting frequency response. Dolby circuitry is precisely set at the factory and can be activated by a single switch on the front panel.

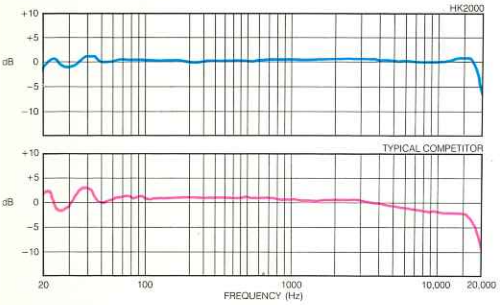
The HK2000 provides **automatic shut-off** in all forward modes and rewind.

An accurate **digital tape counter** with a reset button is provided.

A **Memory control** permits the user to locate a selection anywhere on the tape and eliminates the bothersome search for the exact **start** location.



Playback signal distortion is strongly influenced by the material from which the playback head is constructed. Permalloy heads are capable of handling higher playback signal levels without saturation and attendant distortion.



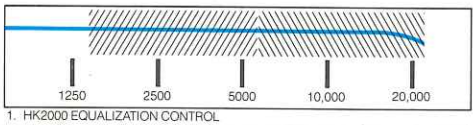
Head bumps, the rising and falling effect at low frequencies, are a function of playback head geometry, or contour, and its interaction with certain wavelengths of the recorded signal. Keeping this contour effect to a minimum assures accurate bass response.

Phase Linearity

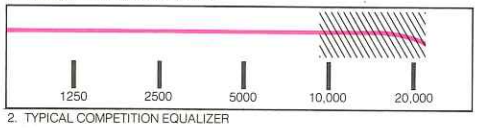
Harman Kardon engineers have long recognized the role of phase linearity as it affects faithful reproduction of an incoming signal. Thus, each operating section of the HK2000 has been engineered to maintain optimum phase linearity. Amplitude is consistent across the entire audio band. The frequency response envelope is ± 3 decibels from 20Hz to 16kHz. We know of no cassette deck in the range of the HK2000 which can come close to duplicating either its bandwidth or its linear response. The HK2000 maintains a tight frequency response because it permits many equalization options; thus, the response curve can be tailored precisely.

Signal-to-Noise Ratio

Noise is the most disturbing of all forms of distortion, and is particularly troublesome in the cassette format. The HK2000, with its Dolby circuits, reduces noise to levels that are at the limit of the random noise exhibited by blank tape. Radically new technology in tape formulations must develop before the noiseless performance of the HK2000 is surpassed.



1. HK2000 EQUALIZATION CONTROL



2. TYPICAL COMPETITION EQUALIZER

Equalization control in the HK2000 is effected by two adjustments per channel of each of the two positions of the tape selector—eight in all. The first controls a band width extending from 1500 Hz to slightly beyond 6kHz. The second effects the range from 6.8kHz to beyond 20kHz. Thus, the HK2000 allows total control over a range of almost four musical octaves.

In most other designs a much simpler, and less accurate control of equalization is employed. A typical circuit of this type influences the frequency band from about 10kHz to beyond 20kHz—a range of little more than one musical octave.

DOLBY is a trademark of Dolby Laboratories, Inc.

HK2000 Specifications

The HK2000 cassette deck has been designed and manufactured with the same meticulous detail that is characteristic of all Harman Kardon products. We can say with absolute confidence that it meets the exceedingly high standards of sound quality set for it by its creators.

Tape Speed:	1⅞ IPS
Wow and Flutter:	0.07% or less
Drift:	±1.5%
Tape Speed Error:	±1.5%
Fast Forward and Rewind Time:	90 seconds or less for C60 cassette
Total Harmonic Distortion:	Better than 1.5% at 1kHz, −2dB from zero VU
Output Level:	1350 millivolts at zero VU rec/play and zero VU play
Frequency Response:	20 Hz to 16kHz ±3dB (FeO or CrO_2)
Signal/Noise Ratio:	−62dB with DOLBY (A weighting)
Sensitivity:	Microphone: 0.2mV. Low Level Input: 50mV High Level Input: 200 mV
Bias Frequency:	105kHz ±3kHz
Erase Ratio:	60dB at 1kHz, zero VU, all type tapes
Channel Separation:	Greater than 34dB
Channel Crosstalk:	60dB
Microphone Input Impedance:	600 ohms
Auxiliary Input Impedance:	30k ohms (low level). 50k ohms (high level)
Headphone Impedance:	8 ohms
Channel Balance:	± 1dB
Azimuth Differential:	1dB at 10kHz
Dimensions:	15″ Wide x 10¼″ Deep x 5⅜″ High (38.1 cm. W x 26.0 cm D x 13.6 cm. H)
Weight:	16 pounds (7.26 kg)

harman/kardon 55 Ames Court, Plainview, N.Y. 11803

Printed in U.S.A. All specifications and features are subject to change without notice.

RECV'D. GR. 290 9-17-77